Fishery Data Series No. 95-42

Sport Fishing Effort, Catch, and Harvest and Inriver Abundance of Chilkat River Chinook Salmon Near Haines, Alaska, in 1994

by

Randolph P. Ericksen

December 1995

Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 95-42

SPORT FISHING EFFORT, CATCH, AND HARVEST AND INRIVER ABUNDANCE OF CHILKAT RIVER CHINOOK SALMON NEAR HAINES ALASKA, IN 1994

by
Randolph P. Ericksen
Division of Sport Fish, Haines

Alaska Department of Fish and Game
Division of Sport Fish
Anchorage, Alaska

December 1995

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-10, Job No. S-1-5.

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Ericksen, Randolph P.
Alaska Department of Fish and Game, Division of Sport Fish
Box 330, Haines, AK 99827-0330, USA

This document should be cited as:

Ericksen, Randolph P. 1995. Sport fishing effort, catch, and harvest and inriver abundance of Chilkat River chinook salmon near Haines, Alaska, in 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-42, Anchorage.

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ABSTRACT

The Haines marine boat sport fishery targets wild mature chinook salmon *Oncorhynchus tshawytscha* returning to the Chilkat River. Stratified two-stage direct expansion surveys were used to estimate angler effort for and harvest of, wild mature chinook salmon assumed to be bound for the Chilkat River in the Haines marine boat fishery during the spring of 1994. Harvest of large (greater than 28 inches in total length) chinook salmon and chartered angler effort and harvest were also estimated. Contributions of hatchery chinook salmon to the fishery were estimated from coded wire tag recovery information. Age and size compositions of the harvest were estimated using scale samples and lengths collected from chinook salmon in the angler harvest. A mark-recapture experiment was used to estimate abundance of age 1.3 and older fish returning to the Chilkat River in 1994.

An estimated 9,726 angler-hours (SE = 723) of effort (7,682 targeted salmon hours, SE = 597) were expended for a harvest of 220 (SE = 32) large chinook salmon, of which 190 (SE = 29) were wild mature fish. Chartered anglers accounted for 12% and 21% of the estimated targeted salmon effort and harvest of large chinook salmon, respectively. Hatcheries produced about 3% of the estimated chinook salmon harvest in the surveyed fishery.

Three hundred one (301) large (age 1.3 and older) chinook salmon were captured in the lower Chilkat River between June 14 and July 22, 1994 in drift gill nets and two fish wheels. Two hundred ninety-six (296) of these fish were tagged with solid-core spaghetti tags (212 in drift gill nets and 84 in the fish wheels). A total of 777 large chinook salmon were examined on spawning tributaries to the Chilkat River and 33 of these were marked. Based on these data, an estimated 6,795 (SE = 1,057) large chinook salmon (n_1 = 296, n_2 = 777, m_2 = 33) immigrated into the Chilkat River during 1994.

Key words: Creel survey, angler effort and harvest, boat sport fishery, hatchery, escapement, mark-recapture, coded wire tag, age composition, length-at-age estimation, chinook salmon, *Oncorhynchus tshawytscha*, Chilkat River, Kelsall River, Tahini River, Big Boulder Creek, Nataga Creek, Haines, Southeast Alaska.

INTRODUCTION

The Chilkat River is a large glacial system that originates in British Columbia, Canada, flows through dissected mountainous terrain, and terminates in Chilkat Inlet near Haines Alaska (Figure 1). The watershed contains about 350 km of river channel covering about 1,600 square km (Bugliosi 1988), and produces the third largest population of chinook salmon *Oncorhynchus tshawytscha* in Southeast Alaska occurs in the Chilkat River (Pahlke 1993).

Each spring a marine boat sport fishery in Chilkat Inlet (Figure 1) targets mature chinook salmon returning to the Chilkat River. A creel survey has been used to estimate harvest in this fishery since 1984. The harvest in this fishery peaked at over 1,600 chinook salmon in 1985 and 1986 (Neimark 1985, Mecum and Suchanek 1986, and 1987, Bingham et al. 1988, Suchanek and Bingham 1989, 1990, and 1991, Ericksen 1994). This fishery has been popular with both local and non-local anglers; an estimated 61% of the anglers that fished in 1985 were not from Haines (Bethers 1986). In 1988, an estimated 1.1 million dollars were spent by anglers fishing in Haines and Skagway for chinook salmon (Jones and Stokes 1991). The Haines King Salmon Derby, which began in the mid 1950's, was directed primarily at returning Chilkat River chinook salmon.

In 1985 and 1986, counts of spawning chinook salmon in Stonehouse and Big Boulder creeks (Figure 1), two index areas of the Chilkat River (see Pahlke 1992), declined coincident with high harvests of chinook in the commercial troll, commercial drift gill net, and marine sport fisheries in the area. This prompted the Alaska Department of Fish and Game to restrict fisheries in upper Lynn Canal beginning in 1987 and entirely close sport fisheries in 1991 and 1992. These closures also resulted in suspension of the Haines King Salmon Derby beginning in 1988.

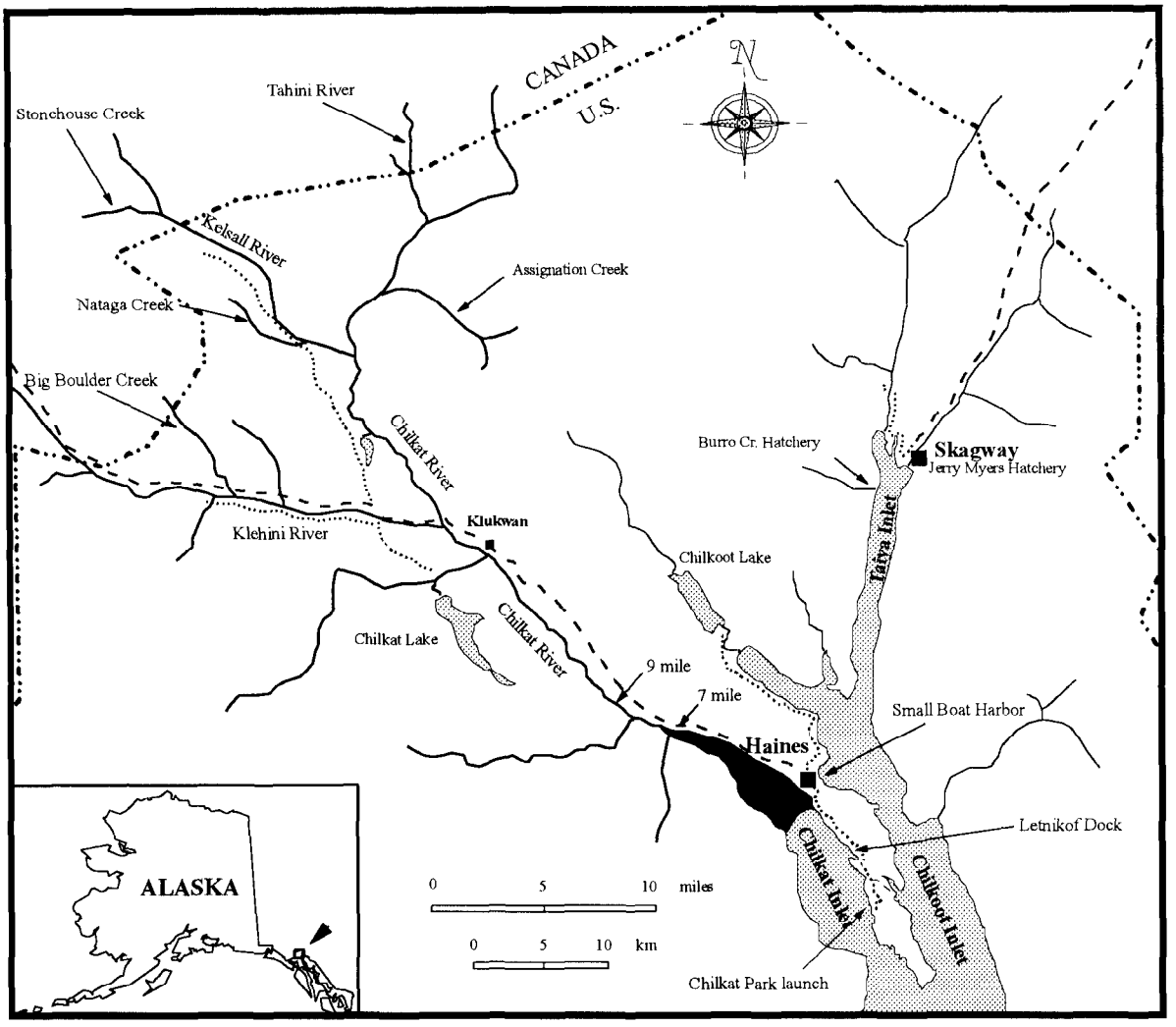

Figure 1.-Location of sampling sites and release sites of coded wire tagged chinook salmon near Haines and Skagway, Southeast Alaska, 1994.

To address possible conservation concerns, radio telemetry was used to estimate spawning distribution of large (age 1.3 +) chinook salmon in 1991 and 1992 and mark recapture experiments were used to estimate their abundance in 1991-1993. Results of this research indicated that most of the chinook spawn in two major tributaries of the Chilkat River, the Kelsall and Tahini Rivers (Johnson et al. 1992 and 1993) and that abundance ranged from 4,472 (SE = 851) to 5,897 (SE = 1,005) (Johnson et al 1992, 1993 and Johnson 1994).

Encouraged by these findings, the Department reopened the spring sport fishery in 1993 and managed the fishery for a maximum harvest of 500 wild mature chinook (Ericksen 1994). This conservative strategy was continued in 1994. In addition, the following sport fishing regulations were in effect:

1. Chilkat Inlet north of a line extending from a department marker one mile south of Anchor Point and to a department marker directly north of the Letnikof Cove boat launch, was closed to fishing for king

salmon from April 15 through July 15 (Figure 2);

2. A seasonal limit of two king salmon 28 inches or more in length, per person, was in effect from April 15 through July 15, in salt waters of Chilkat Inlet, and in Lynn Canal north of the latitude of north tip of Sullivan Island and south of the latitude of Mud Bay Point. Any king salmon less than 28 inches in length were required to be released.

The research objectives in 1994 were:

1. to estimate the harvest of wild mature chinook salmon in the Haines spring marine boat sport fishery from May 9 to July 3, 1994; and,
2. to estimate the 1994 immigration of large (≥age 1.3) chinook salmon into the Chilkat River.

A creel survey was used to obtain weekly estimates of the harvest of wild mature chinook salmon. A mark-recapture experiment was conducted to monitor the escapement of large chinook salmon to the Chilkat River. This information was collected as part of a long-term program to develop spawner-recruit relationships for this population, estimate spawning requirements, and identify surplus production.

METHODS

HARVEST SURVEY

Stratified multi-stage direct expansion creel surveys were used to estimate the harvest of chinook salmon in the Haines marine boat sport fishery. Strata were defined by 7-day (weekly) one high-use site and 14-day (biweekly) periods at 2 low-use sites. Data summaries were prepared weekly to facilitate inseason harvest estimates and would have provided a basis for inseason management if the estimated total harvest reached, or was expected to reach, 500 fish.

The three access locations were the Letnikof Dock (the high-use site), the Chilkat State Park boat launch, and the Small Boat Harbor (Figure 1). Prior surveys indicate that anglers originated from the Letnikof Dock accounted for 62%-93% of the harvest of chinook salmon.

Each fishing day was defined as starting at 0800 and ending at civil twilight. The survey at Letnikof Dock also contained morning/evening stratification with relatively longer evening strata and weekend/weekday stratification of the evening strata during the peak of the season. Sampling densities with two technicians were expected to yield an overall relative precision (95% confidence intervals) of about ±35%. Sampling at each location had days as primary sampling units and boat-parties as secondary units.

Sampling at Letnikof Dock occurred from May 9 to July 3, 1994. Morning sampling strata lasted from 0800 to two hours before mid-day, and evening sampling strata lasted from two hours before mid-day to civil twilight. Thus, evening strata were four hours longer in duration than morning strata. This stratification scheme was designed to maximize sampling during hours when most of the anglers exited the fishery, increasing the precision of the estimates. Random selections determined primary units to sample in each strata. Two morning and three evening strata were sampled each week, except as noted below.

During the peak of the fishery (May 16 through June 12) the evening strata at Letnikof Dock was further divided into weekday and weekend/holiday stratification defined by Saturdays, Sundays, May 23 (Victoria Day), and May 30 (Memorial Day). During this peak season, two morning, two weekday evening, and two weekend/holiday

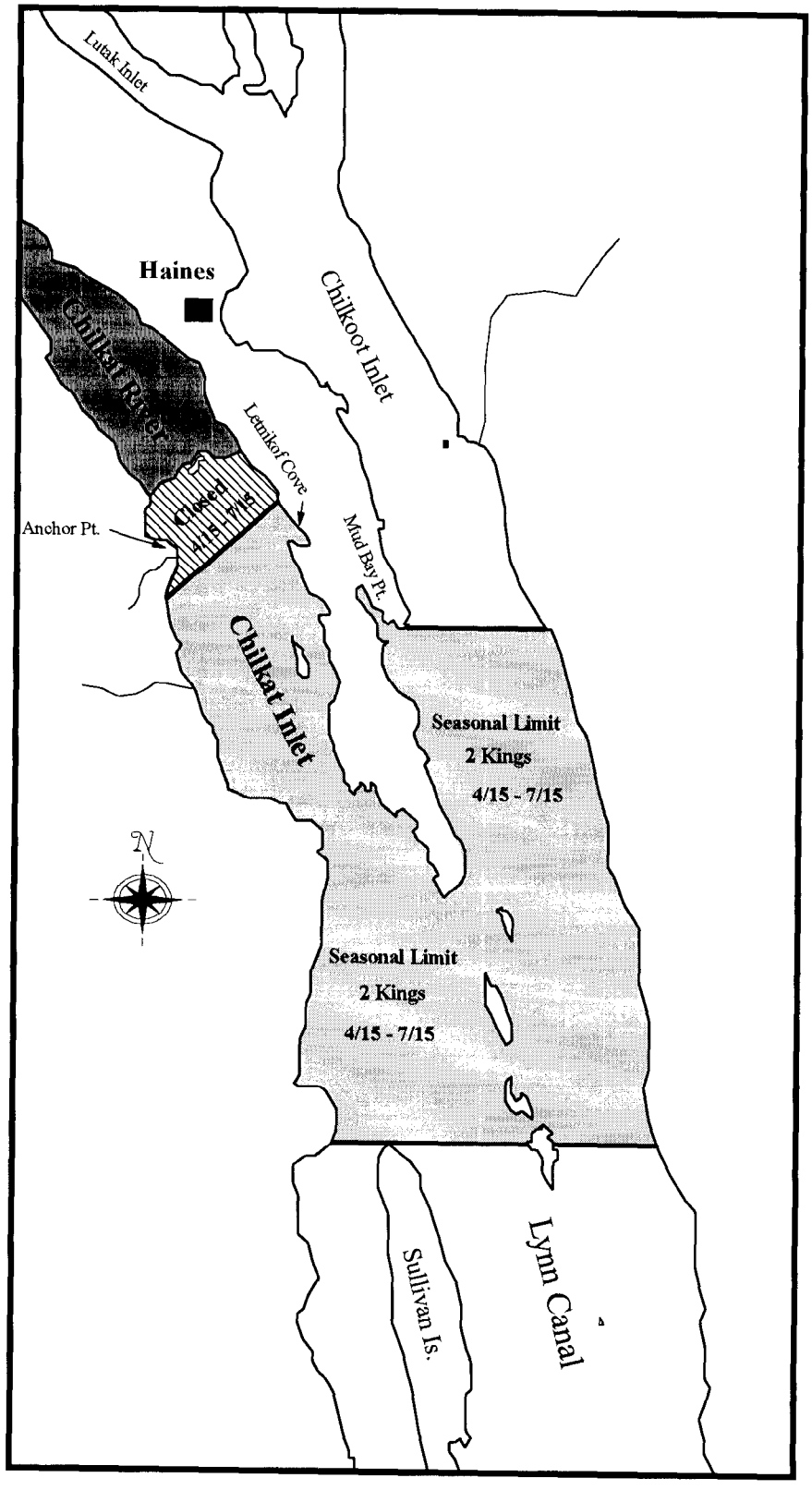

Figure 2.-Location of the 1994 Haines marine chinook salmon sport fishing regulatory area.

evening periods were sampled each week. A total of twenty unique strata were sampled at Letnikof Dock in 1994.

Sampling at the Small Boat Harbor and Chilkat State Park boat launch was initiated on May 9 and May 23, respectively, and continued through July 3. There was no type-of-day stratification at the low-use sites, so each sampling bi-weekly period was divided into 14 morning and 14 evening periods of equal length. Random selections determined primary units to sample in each morning and evening strata. To accommodate the impossibility of sampling three sites simultaneously with only 2 technicians, seven changes (period moves) were made to the randomized sampling schedule at low-use sites. A total of fourteen unique strata were sampled at the low-use harbors during 1994.

During each sample period, all sport fishing boats returning to the harbor were counted. Boat-parties returning to the dock were interviewed to determine: the number of rods fished; hours fished; type of trip (charter or noncharter); target species (chinook salmon, Pacific halibut *Hippoglossus stenolepis*); and number of fish kept and/or released by species. Interviewing boat-parties also included sampling all harvests of chinook salmon for maturity and missing adipose fins. Maturity was also determined (Ericksen 1994, Appendix A). In rare cases, some parties were not interviewed, or maturity status could not be determined. When one or more boat-parties could not be interviewed, total effort and catch for the strata was estimated by expanding by the total number of parties returning to the dock during that period. Similarly, when a boat-party had fish with nondeterminant maturity status, interview information for that boat-party was ignored and expansions (by sample period) were made from harvests by remaining boat-parties and the total number of boat-parties counted.

The harvest in each stratum ($\hat{H}_h$) was estimated (Cochran 1977)

$$\hat{H}_h = D_h \overline{H}_h \tag{1}$$

$$\overline{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \tag{2}$$

$$\hat{H}_{hi} = M_{hi} \frac{\sum_{j=1}^{m_{hi}} h_{hij}}{m_{hi}} \tag{3}$$

where h_{hij} = harvest on boat j in sampling days (periods) i stratum h,

m_{hi} = number of boat parties interviewed in day i,

M_{hi} = number of boat-parties completed in day i,

d_h = number of days (morning or evening periods) sampled in stratum h, and

D_h = number of days in stratum h.

The variance of the harvest by stratum is estimated

$$V\left[\hat{H}_h\right] = (1 - f_{1h}) D_h{}^2 \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \overline{H}_h)^2}{d_h (d_h - 1)} + \tag{4}$$

$$D_h \sum_{i=1}^{d_h} M_{hi}{}^2 (1 - f_{2hi}) \frac{\sum_{j=1}^{m_{hi}} (h_{hij} - \overline{h}_{hi})^2}{d_h m_{hi} m_{hi} - 1)}$$

where f_{1h} = sampling fraction for periods and f_{2hi} = sampling fraction for boat-parties. Catch and effort is estimated similarly, substituting C and E for H in Eq. (1) through Eq. (4). Total harvests for the season are the sums across strata ΣH_h and $\Sigma V[H_h]$.

Chinook salmon sampled in the angler harvest were measured to the nearest 5 mm in fork length. Five scales were removed from the left side of each sampled fish (right side if left side scales were regenerated), along a line 2 scale rows above the lateral line between the posterior insertion of the dorsal fin and

anterior insertion of the anal fin. A triacetate impression of the scales (30 seconds at 7,000 kg/sq^2, at a temperature of 97°C) was used for age determination. Scales were aged using procedures in Olsen (1992). Information recorded for each chinook salmon sampled included sex, length, maturity, and the presence or absence of adipose fins. Heads from chinook salmon missing adipose fins were retained by technicians. A locking plastic strap with a unique number was inserted through the jaw of the head. Heads and coded wire tag (CWT) recovery data were sent to the ADF&G CWT Processing Laboratory in Juneau, where any tags present were removed, decoded, and corresponding information was entered into the tag lab data base.

Age composition and mean length-at-age of chinook salmon in the sport fishery harvest, and associated variances were estimated using standard normal statistics.

An estimate of the contribution $\hat{n}_1$ of hatchery and wild CWT chinook salmon to the Haines marine sport fishery was calculated for each stratum, then summed across strata and across fisheries to obtain an estimate of the total harvest:

$$\hat{N}_c = \sum_{h=1}^{L} \hat{n}_{1h} \qquad V[\hat{N}_c] = \sum_{h=1}^{L} V[\hat{n}_{1h}] \tag{5}$$

where L is the number of strata. The variance of the sum of the estimates was calculated as the sum of the variances across strata because sampling was independent across strata and across fisheries. Sampled chinook salmon in the angler harvest were counted and inspected for missing adipose fins. Heads of all recaptured salmon were retrieved, marked, and sent to Juneau for dissection. Heads that arrived in Juneau were passed through a magnetometer to detect a CWT and were dissected if the presence of metal was indicated. If a CWT was found and the tag was undamaged, its code was read under a microscope

Information from the creel survey was expanded to estimate harvest of each CWT code recovered for each stratum. The harvest in a stratum was calculated as

$$\hat{n}_1 = \frac{m_1 a_1}{m_2 a_2} \frac{H}{n_2} \frac{m_c}{\hat{\theta}} = H \hat{\theta}^{-1} \hat{M} \tag{6}$$

where $\hat{M}$ is the final statistic obtained through sampling the sport harvest, n_2 is the total number of chinook sampled in the stratum, a_1 is the total number of adipose clips sampled in n_2, a_2 is the total number of heads in a_1 received at tag lab, m_1 is the number of tags detected in a_2, m_2 is the total number of tags decoded in m_1, and m_c is the number of CWT's in m_2 with given tag code. The bootstrap of Efron (1982) as modified by Buckland and Garthwaite (1991) was used to estimate M, and its variance. A multinomial, empirical density distribution with six cells was created with the data from the catch sampling program. The probabilities of drawing a single sample from this distribution were calculated from the original data as follows:

$$\frac{n_2 - a_1}{n_2} \quad \frac{a_1 - a_2}{n_2} \quad \frac{a_2 - m_1}{n_2} \quad \frac{m_1 - m_2}{n_2} \quad \frac{m_2 - m_c}{n_2} \quad \frac{m_c}{n_2}$$

The bootstrap began with drawing a sample of size n_2 with replacement from the empirical distribution according to the probabilities based on the original data. One thousand such samples were drawn, and the results of each (say the bth sample) were tallied to obtain a new set of statistics $\{a_1^*, a_2^*, m_1^*, m_2^*, m_c^*\}_b$ and a value of M_b. The mean of M_b ($\overline{M}$) and its variance $V[\overline{M}]$ were calculated for each stratum as

$$V[\overline{M}] = \frac{\sum_{b=1}^{B} (M_b - \overline{M})^2}{B - 1} \quad \text{with} \quad \overline{M} = \frac{\sum_{b=1}^{B} M_b}{B} \tag{7}$$

where B is the number of bootstrap samples drawn (=1000).

ABUNDANCE ESTIMATE

A mark-recapture experiment was used to estimate the number of large chinook salmon returning to the Chilkat River in 1994. Marks were applied to fish captured in the lower Chilkat River with drift gill nets and fish wheels from June 14 through July 22, between the area adjacent to Haines Highway miles 7 and 9. Large chinook salmon were marked with a solid-core spaghetti tag and a hole punch in the upper left operculum, prior to release. Fish were examined for marks on three spawning tributaries of the Chilkat River between August 3 and September 3. Expected relative precision (95% confidence intervals) for the experiment was about ±27%.

LOWER RIVER MARKING

Gill nets 21.3 m long and 3.0 m deep (70 ft x 10 ft) with a 18.5 cm (7.25 in) stretched mesh were drifted from June 14 through July 21, 1994. Each day an attempt was made to complete 43 drifts between 0600 and 1400 hours. Fishing was conducted from an 18-foot boat in three adjoining 0.5 km long areas, which were marked along the same 1.5 km long stretch of river used in 1993 (see Figure 2 in Johnson 1994). This section of the river was approximately 100 m wide and 2 to 3 m deep. The 43 drifts took about 6 hours to complete when fish were not captured. Fishing continued uninterrupted from area 1 to area 2, and then to area 3 if fish were not captured. If a (0.5 km) drift was prematurely terminated because a fish was caught, or if the net became entangled or drifted into shallow water, the terminated drift was subsequently completed before a new drift was started. If 43 drifts could not be completed during the day, additional drifts were added to the next days total to make up the balance.

Two four-basket fish wheels were installed by ADF&G Commercial Fisheries Management and Development Division (CFMAD) personnel early in the season to monitor the escapement of sockeye salmon *O. nerka* to the Chilkat River. We provided funding for one technician to work on the fish wheels in exchange for CFMAD tagging of captured chinook. One fish wheel operated adjacent to the Haines Highway mile 8 from June 16 through July 22, and another adjacent to mile 9 from June 17 through July 22. The wheels were located along the east bank of the river where the main flow was constrained to one side of the floodplain. Fish wheels were operated continuously except for maintenance.

Captured chinook salmon were placed in a water filled tagging box (see Figure 3 in Johnson 1994) inspected for missing adipose fins, and measured to the nearest 5 mm, mid-eye-to-fork length (MEF). Fish were initially classified as "large" or "small," depending on their length: fish ≥660 mm MEF were designated large, and fish <660 mm MEF were designated small. Healthy large chinook salmon were scale sampled, visually "sexed", and marked with a uniquely numbered spaghetti tag threaded over a solid plastic core, and a one-quarter-inch hole was punched into the upper edge of the left operculum as a secondary mark. Age of each fish was determined at the end of the season from scale pattern analysis (Olsen 1992). Then each fish was reclassified as large or small, using ocean age, rather than length, as criteria; fish with three or more ocean years of residence were classified as large, and younger fish were classified as small. Any fish whose scales could not be aged was classified small or large by using the 660 mm MEF cut-point criteria. Water depth (cm), and temperature (°C) were recorded daily at 0700 and 1330 hours near highway mile 8.

SPAWNING GROUND RECOVERY

Escapements in the Kelsall and Tahini Rivers (Figure 1), which comprised about 90% of the

large chinook salmon spawning in the Chilkat River in 1991 and 1992 (Johnson et al. 1992, 1993) were sampled for marks by two teams of two people. Spawning grounds in the Kelsall River (including Nataga Creek) were sampled from August 5 to September 3. Spawning grounds in the Tahini River were sampled from August 10 to September 3. Chinook salmon were also sampled in Big Boulder Creek from August 3 through August 19 with assistance from CFMAD staff. Chinook salmon were captured with gill nets, dip nets, bare hands, and spears. Double sampling was prevented by punching a hole in the lower edge of the left operculum of all captured fish.

Abundance (numbers immigrating) was estimated using the Chapman's modified Petersen estimator for a closed population (Seber 1982).

$$\hat{N} = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1 \qquad (8)$$

where n_1 = number of large chinook salmon marked in the lower river,

n_2 = number of large chinook salmon examined on the spawning grounds, and

m_2 = number of marked fish recaptured on the spawning grounds.

The variance of the abundance is estimated

$$V[\hat{N}] = \frac{(n_1+1)(n_2+1)(n_1-m_2)(n_2-m_2)}{(m_2+1)^2(m_2+2)} \qquad (9)$$

Age composition, mean length-at-age, and variances of the catch in each gear type were calculated using standard normal statistics.

RESULTS

ANGLER EFFORT AND HARVEST

An estimated total of 9,726 (SE = 723) angler-hours of effort were expended in the Haines marine boat fishery between May 8 and July 3, 1994 to catch 269 (SE = 41) and harvest 220 (SE = 32) large chinook salmon (Table 1). This was based on a sample of 404 boat-parties who fished a total of 3,167 rod hours of effort (2,921 salmon-hours), and harvested 86 large (28 inches or greater total length) chinook salmon (Appendix A1 through A3). An estimated 190 (SE = 29) of the chinook salmon harvested in this fishery were wild mature fish assumed to be returning to the Chilkat River. Approximately 79% (7,682 salmon-hours, SE = 592) of the angler effort was targeted on chinook salmon. The remainder was directed toward other species, primarily Pacific halibut. An estimated 194 (SE = 55) small (sub-legal, less than 28 inches total length) chinook salmon were caught and 7 (SE = 7) were harvested (illegally). Seventy-three percent of the estimated salmon effort and 88% of the estimated harvest of chinook salmon occurred between May 23 and June 19 (Table 1). Angling pressure for chinook salmon was relatively small during the first and last two weeks, so our coverage of the fishery for mature chinook salmon was essentially complete. Estimates by site are shown in Appendices A1 through A3. Charter boat anglers accounted for about 12% of the salmon effort (956 salmon-hours, SE = 132), and 21% of the harvest (46, SE = 19) of chinook salmon in this fishery.

Anglers returning to the Letnikof Dock were responsible for 69% of the estimated salmon effort (5,284 salmon-hours, SE = 434) and 79% of the estimated harvest (213, SE = 37)

Table 1.-Total estimated effort, catch, and harvest of chinook salmon, with estimates of precision, in the Haines marine boat sport fishery, by bi-week, May 9 through July 3, 1994.

	May 09 May 22	May 23 June 05	June 06 June 19	June 20 July 03	Total
Angler-hours					
Estimate	949	2,512	3,190	3,075	9,726
Variance	40,283	111,391	98,587	271,942	522,203
Precision[a]	0.41	0.26	0.19	0.33	0.15
Salmon-hours					
Estimate	867	2,417	3,169	1,229	7,682
Variance	31,461	107,497	96,697	121,004	356,659
Precision	0.40	0.27	0.19	0.55	0.15
Large Chinook Catch					
Estimate	5	46	199	19	269
Variance	4	82	1,511	82	1,679
Precision	0.78	0.39	0.38	0.93	0.30
Large Chinook Kept					
Estimate	5	44	152	19	220
Variance	4	84	868	82	1,038
Precision	0.78	0.41	0.38	0.93	0.29
Wild Mature Chinook Kept (excluding hatchery and immature fish)					
Estimate	5	34	134	17	190
Variance	4	74	681	66	825
Precision	0.78 c	0.50	0.38	0.94	0.30
Small Chinook Catch					
Estimate	1	93	93	7	194
Variance	0	2,001	1,002	15	3,018
Precision		0.94	0.67	1.08	0.56
Small Chinook Kept					
Estimate	0	0	7	0	7
Variance			46		46
Precision			1.90		1.90

[a] Relative precision = 1.96 Standard Error/estimate.

of large chinook salmon (Appendix A1). Anglers returning to the Chilkat State Park boat launch and the Small Boat Harbor accounted for an estimated 1,208 (SE = 365) and 1,190 (SE = 187) salmon-hours of effort, respectively, and harvests of 35 (SE = 14) and 21 (SE = 11) large chinook salmon (Appendices A2 and A3), respectively. Since the projected harvest of wild mature chinook salmon did not approach 500, the fishery remained open for the entire season.

AGE AND LENGTH OF HARVESTED CHINOOK SALMON

A total of 84 chinook salmon were sampled for age and length during the study. Sixty-seven (67) of these were assigned an age (Table 2). Most (60.7%, SE = 5.4%) of the chinook harvested were female. The predominate age class was age-1.4 (58.2%, SE = 6.1%).

CONTRIBUTIONS OF CODED WIRE TAGGED STOCKS TO THE SPORT FISHERY

Eighty four (84) chinook salmon were examined for adipose fin clips in the Haines marine fishery between May 9 and July 3. Eleven of those were missing adipose fins, of which nine had CWT's that were decoded. Both hatchery (6, SE = 4) and wild coded wire tagged chinook salmon (24, SE = 9) were recovered (Table 3). Total contributions of wild tagged stocks could not be estimated as tagging fractions have not yet been determined for the 1988 and 1989 brood years. Final tagging fractions for the 1989 brood will be available after the 1996 season, however the expanded estimate should be equal to the estimated harvest of wild mature chinook salmon (190, SE = 29).

All of the randomly sampled hatchery fish were Tahini River (Chilkat River drainage) stock, reared in Southeast Alaska hatcheries and released in either the Tahini River, or in northern Lynn Canal. Wild coded wire tagged stocks were all tagged in the Chilkat River drainage (Chilkat River, Kelsall River, Tahini River, see Figure 1).

ABUNDANCE ESTIMATE

Three hundred one (301) large (age 1.3 and older) and 159 small chinook salmon were captured in the lower Chilkat River between June 14 and July 22, 1994 (Table 4, Figure 3). Capture rates peaked on July 9. The mean date of migratory timing (when 50% of the immigration has occurred, Mundy 1984) in the lower river was July 5 (Figure 4). Two hundred fourteen (214) large and one small chinook salmon were captured in the drift gill net and 87 large and 158 small were captured in the fish wheels (Table 4). Fish captured in the gill net were predominately female (61.4%) and age 1.4 (62.6%) (Table 5). In contrast, fish captured in the fish wheels were mostly male (86.7%) and age 1.1 (61.6%) (Table 5). Large chinook salmon captured in the fish wheels were significantly smaller in size (K-S test, $d_{max} = 0.192$, $P = 0.023$) and had a significantly higher proportion sexed as male ($\chi^2 = 16.5$, df = 1, $P = 0.0001$) than those captured in the gill net. Of the 301 large fish captured, 296 were given an external spaghetti tag. Three fish captured in the fish wheels were previously marked in the drift gill net and two fish captured in the drift gill net were sampled for CWT's, and not tagged.

Seven hundred seventy-seven (777) large and 64 small chinook salmon were examined on the spawning grounds for marks (Table 6). Thirty-three (33) large tagged fish were marked (Table 6). Sex ratios on the spawning grounds were roughly equal (Table 5) with a slightly higher proportion of females on the Tahini River (58.6%) and the Kelsall River (55.6%). The probability of capturing a marked chinook salmon on the two main spawning areas (Kelsall and Tahini Rivers)

Table 2.-Estimated age composition and mean length-at-age of chinook salmon harvested in the Haines Marine boat sport fishery, May 9 through July 3, 1994.

	Brood year and age class					
	1990	1989	1988	1987	Total	Total
	1.2	1.3	1.4	1.5	aged	sampled[a]
Male						
Sample size	2	9	16	0	27	33
Percent	7.4	33.3	59.3			39.3
SE	5.1	9.2	9.6			5.4
Mean Length[b]	673	840	961			
SE	12	13	20			
Female						
Sample size	0	16	23	1	40	51
Percent		40.0	57.5	2.5		60.7
SE		7.8	7.9	2.5		5.4
Mean Length		867	959	1090		
SE		9	8			
All						
Sample size	2	25	39	1	67	84
Percent	3.0	37.3	58.2	1.5		
SE	2.1	6.0	6.1	1.5		
Mean Length	673	857	960	1090		
SE	7	8	9			

[a] Includes fish that were not assigned an age.

[b] Length measured snout to fork of tail in mm.

Table 3.-Contribution estimates of hatchery produced and wild coded wire tagged chinook salmon to the Haines marine sport fishery, with statistics[a] used for computing estimates, by bi-week, 1994. The tagging fraction, θ for both of the hatchery releases was 100%, and will not be known for wild stocks until 1996.

Hatchery	Release site	Tag code	Brood year	Bi-week	N[a]	Var[N]	n_2	a_1	a_2	m_1	m_2	m_c	Estimate	SE
Hidden Falls	Lutak Inlet	04-32-38	88	5/23-6/05	46	82	21	4	4	3	3	1	2	2
			Release site contribution										2	2
Jerry Myers	Tahini River	04-01-011009	89	6/06-6/19	199	1,511	54	7	7	6	6	1	4	4
			Release site contribution										4	4
Wild stock	Chilkat River	04-33-37	88	5/23-6/05	46	82	21	4	4	3	3	1	2	2
		04-33-37	88	6/06-6/19	199	1,511	54	7	7	6	6	1	4	4
		04-27-10	88	6/06-6/19	199	1,511	54	7	7	6	6	1	4	4
			BY88 wild tag contribution[b]										10	6
Wild stock	Chilkat River	04-33-39	89	6/06-6/19	199	1,511	54	7	7	6	6	1	4	4
	Kelsall River	04-33-47	89	6/06-6/19	199	1.511	54	7	7	6	6	1	4	4
	Tahini River	04-33-38	89	5/23-6/05	46	82	21	4	4	3	3	1	2	2
	Tahini River	04-33-38	89	6/06-6/19	199	1,511	54	7	7	6	6	1	4	4
			BY89 wild tag contribution[b]										14	7

[a] N = estimated harvest of large chinook, Var[N] = Variance of N, n_2 = number of chinook sampled, a_1 = number of adipose clips in n_2, a_2 = heads received at tag lab, m_1 = number of tags detected in a_2, m_2 = tags decoded in m_1, m_c = number of CWT's in m_2 with given tag code.

[b] Estimated harvest of wild chinook salmon of the noted tag code, not expanded by tagging fraction (θ).

Table 4.-Numbers of chinook salmon caught in the lower Chilkat River by time period, gear type, and size, June 14 through July 22, 1994.

	Drift gill net		Fish wheels		
	Large	Small	Large	Small	Total
6/14-6/18	5	0	0	1	6
6/19-6/23	34	1	3	6	44
6/24-6/28	24	0	12	36	72
6/29-7/03	29	0	23	34	86
7/04-7/08	43	0	13	42	98
7/09-7/13	50	0	25	26	101
7/14-7/18	21	0	8	10	39
7/19-7/22	8	0	3	3	14
Total	214	1	87	158	460

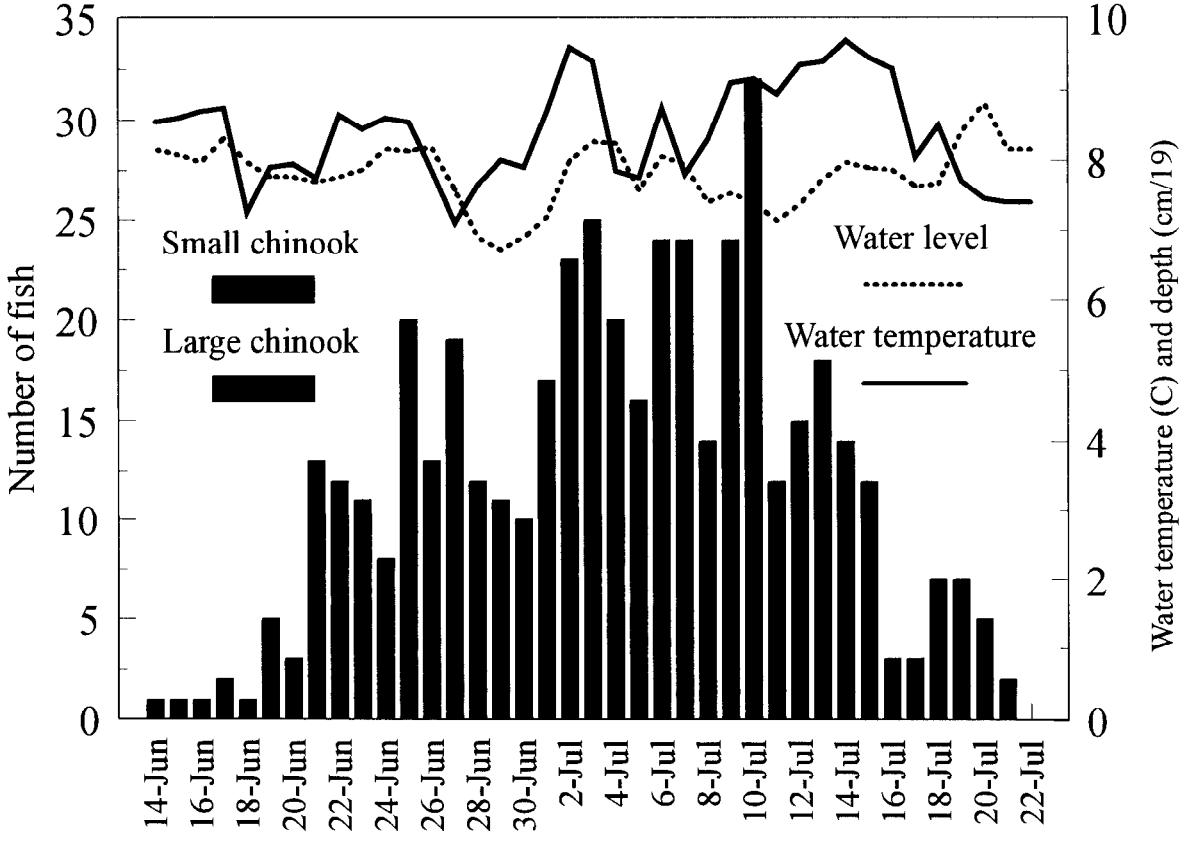

Figure 3.-Daily water depth (cm/19), temperature (°C), and catch of small (<age 1.3) and large (≥age 1.3) chinook salmon catch in drift gill nets and fish wheels operating in the lower Chilkat River, June 14 through July 22, 1994.

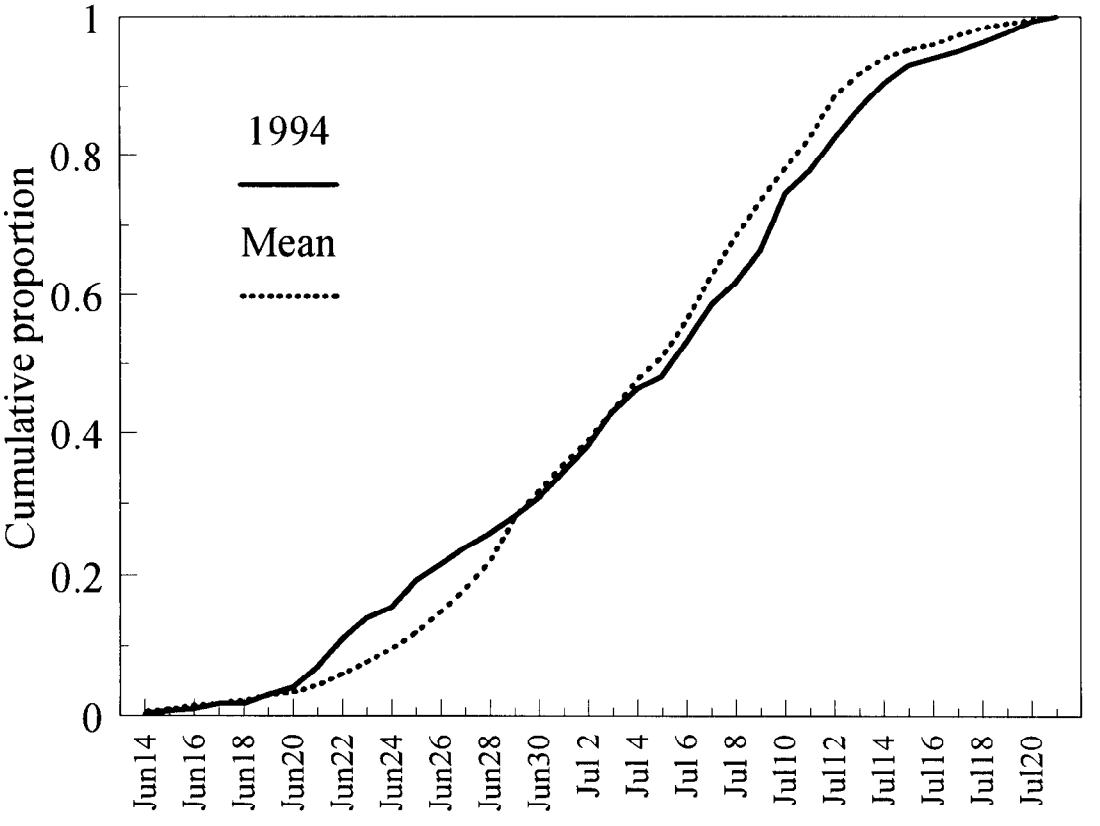

Figure 4.-Cumulative proportion of large (≥age 1.3) chinook salmon captured with drift gill nets in the lower Chilkat River in 1994 compared with the mean cumulative proportion, 1991-1994.

Table 5.-Age composition of chinook salmon sampled during tagging and recovery surveys on the Chilkat River drainage, by gear type, 1994.

	Brood year and age class						Total aged	Total sampled[a]
	1991	1990	1989	1988	1987	1987		
	1.1	1.2	1.3	1.4	1.5	2.4		
Tagging: gill net, mile 7.5								
Male								
Sample Size	0	0	29	37	0	0	66	83
Percent			43.9	56.1				38.6
SD			6.2	6.2				3.3
Mean Length			748	896				
SD			67	73				
Female								
Sample Size	0	1	34	75	2	1	113	132
Percent		0.9	30.1	66.4	1.8	0.9		61.4
SD		0.9	4.3	4.5	1.2	0.9		3.3
Mean Length		645	803	865	938	870		
SD			41	44	32			
All Fish								
Sample Size	0	1	63	112	2	1	179	215
Percent		0.6	35.2	62.6	1.1	0.6		
SD		0.6	3.6	3.6	0.8	0.6		
Mean Length		645	778	875	938	870		
SD			61	57	32			
Tagging: fish wheels 8 and 9 mile[b]								
Male								
Sample Size	135	12	22	22	0	0	191	202
Percent	70.7	6.3	11.5	11.5				86.7
SD	3.3	1.8	2.3	2.3				2.2
Mean Length	352	494	762	894				
SD	36	46	65	63				
Female								
Sample Size	0	1	9	18	0	0	28	31
Percent		3.5	32.2	64.3				13.3
SD		3.5	9.0	9.2				2.2
Mean Length		490	772	846				
SD			53	38				
All Fish								
Sample Size	135	13	31	40	0	0	219	233
Percent	61.6	5.9	14.2	18.3				
SD	3.3	1.6	2.4	2.6				
Mean Length	352	494	765	872				
SD	36	44	61	58				

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Table 5.-Page 2 of 3.

	Brood year and age class						Total aged	Total sampled[a]
	1991	1990	1989	1988	1987	1987		
	1.1	1.2	1.3	1.4	1.5	2.4		
Recovery survey: Tahini River spawning grounds								
Male								
Sample Size	23	10	29	35	1	0	98	113
Percent	23.5	10.2	29.6	35.7	1.0			41.4
SD	4.3	3.1	4.6	4.9	1.0			3.0
Mean Length	389	551	774	920	935			
SD	29	76	85	46				
Female								
Sample Size	1	1	43	82	1	0	128	160
Percent	0.8	0.8	33.6	64.1	0.8			58.6
SD	0.8	0.8	4.2	4.3	0.8			3.0
Mean Length	390	620	794	857	890			
SD			42	37				
All Fish								
Sample Size	24	11	72	117	2	0	226	273
Percent	10.6	4.9	31.9	51.8	0.9			
SD	2.1	1.4	3.1	3.3	0.6			
Mean Length	389	557	786	876	913			
SD	28	75	63	49	32			
Recovery survey: Big Boulder Creek spawning grounds								
Male								
Sample Size	1	0	11	9	0	0	21	26
Percent	4.8		52.4	42.9				54.2
SD	4.8		11.2	11.1				7.3
Mean Length	465		760	849				
SD			73	35				
Female								
Sample Size	0	1	12	6	0	0	19	22
Percent		5.3	63.2	31.6				45.8
SD		5.3	11.4	11.0				7.3
Mean Length		580	746	849				
SD			77	58				
All Fish								
Sample Size	1	1	23	15	0	0	40	48
Percent	2.5	2.5	57.5	37.5				
SD	2.5	2.5	7.9	7.8				
Mean Length	465	580	753	849				
SD			74	44				

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Table 5.-Page 3 of 3.

	Brood year and age class						Total aged	Total sampled[a]
	1991 1.1	1990 1.2	1989 1.3	1988 1.4	1987 1.5	1987 2.4		
Recovery survey: Kelsall River/Nataga Creek spawning grounds								
Male								
Sample Size	15	4	74	84	0	0	177	213
Percent	8.5	2.3	41.8	47.5				44.4
SD	2.1	1.1	3.7	3.8				2.3
Mean Length	386	543	778	897				
SD	42	62	66	68				
Female								
Sample Size	0	0	63	139	0	0	202	267
Percent			31.2	68.8				55.6
SD			3.3	3.3				2.3
Mean Length			795	855				
SD			54	48				
All Fish								
Sample Size	15	4	138	225	0	0	382	484
Percent	3.9	1.0	36.1	58.9				
SD	1.0	0.5	2.5	2.5				
Mean Length	386	543	785	870				
SD	42	62	61	59				

[a] Includes fish that were not assigned an age. Not all fish examined for marks were scale sampled (ie. carcass decayed, part of body missing, etc.).

[b] Small chinook salmon (<660mm FL) were only sampled for length at the fish wheels. Fish <440 mm were assumed to be age 1.1. Fish ≥440 and <660mm were assumed to be age 1.2.

Table 6.-Number of chinook salmon inspected for marks and number of marked fish recaptured during tag recovery surveys in the Chilkat River drainage, by location, size, sex, 1994.

		Number inspected				Number marked[a]			
		Large		Small		Large		Small	
Location	Dates	M	F	M	F	M	F	M	F
Kelsall River	8/04-9/04	190	266	20	0	9	14	0	0
Nataga Creek	8/08-8/28	10	16	2	0	0	1	0	0
Tahini River	8/10-9/03	84	166	35	3	3	2	0	0
Big Boulder Creek	8/03-8/19	23	22	3	1	2	2	0	0
Total		307	470	60	4	14	19	0	0

[a] Also included under number of fish inspected.

was not significantly different at $\alpha = 0.05$ ($\chi^2 = 3.581$, df=1, $P = 0.058$), thus data from all spawning areas were combined.

The cumulative distribution function (CDF) of lengths of large chinook salmon marked in the lower Chilkat River was not significantly different from the CDF of large tagged chinook salmon recaptured on the spawning grounds (K-S test, $d_{max} = 0.069$, $P = 0.999$) (Figure 5, top). This suggests that the second sampling event was not size selective. Similarly, the CDF of lengths of marked fish was not significantly different from the CDF of large chinook salmon examined for marks on the spawning grounds (K-S test, $d_{max} = 0.067$, $P = 0.301$)(Figure 5, bottom). Thus, the marking event was not size selective.

An estimated 6,795 (SE = 1,057) large chinook salmon ($n_1 = 296$, $n_2 = 777$, $m_2 = 33$) immigrated into the Chilkat River in 1994. This estimate is germane to the time of tagging in the lower river, since an unquantified removal occurs (due to natural mortality and subsistence fishery harvest) between the two sampling events.

DISCUSSION

In 1993, 45% of the effort and 62% of the harvest originated from the Letnikof Dock (Ericksen 1994). The 1994 estimates that 69% of the salmon effort and 79% of the harvest of chinook salmon originating from the Letnikof Dock is similar to historical distributions prior to 1993. This may have been a result of additional areas reopened to chinook salmon fishing in 1994 that were closer to Letnikof Dock.

The assumptions necessary to apply the estimators for the harvest of wild mature chinook salmon were largely met in the survey. Technicians were confident in assessing whether a fish was mature or immature. All hatchery chinook released in the area were adipose fin clipped and coded wire tagged and no tag codes from other hatcheries (where marking was less than 100%) were recovered in 1995. While some wild fish were given an adipose fin clip and coded wire tagged, this was not a problem since all tags were successfully decoded inseason.

The 1994 estimated harvest of large chinook salmon is similar to the harvest during last four years (1988, 1989, 1990 and 1993) that the fishery was open (Table 7, Figure 6). Sport fishing effort was also similar to that observed in 1989, 1990 and 1993. Catch of large chinook salmon per salmon hour of effort (CPUE) in 1994 was similar to that observed in recent years, but was lower than that observed during the mid-1980s (Table 7). The 1994 effort and harvest did not approach the levels that prompted fishery restrictions in 1987.

The 1994 contribution of hatchery fish to the Haines marine fishery was only 6 fish which is similar to past years (Table 8). The contribution of hatchery chinook salmon to the sport fishery is expected to increase over the next several years, as a result of increased hatchery releases of chinook salmon smolt north of Lynn Canal in recent years (Figure 7). Adult chinook salmon returning from these releases are expected to mill near Haines.

The Haines marine creel survey is an integral part of the management of Chilkat River chinook salmon stocks. The Haines marine sport fishery has been managed for a harvest ceiling beginning in 1987 (excluding 1991 and 1992 when the fishery was closed). Since that time, a marine creel survey has been considered essential to provide inseason estimates of harvest. This survey can also assess enhancement efforts in upper Lynn Canal (Figure 7), and document recoveries of wild coded wire tagged chinook salmon.

In estimating abundance we assumed: (a) tagging of large chinook salmon was in

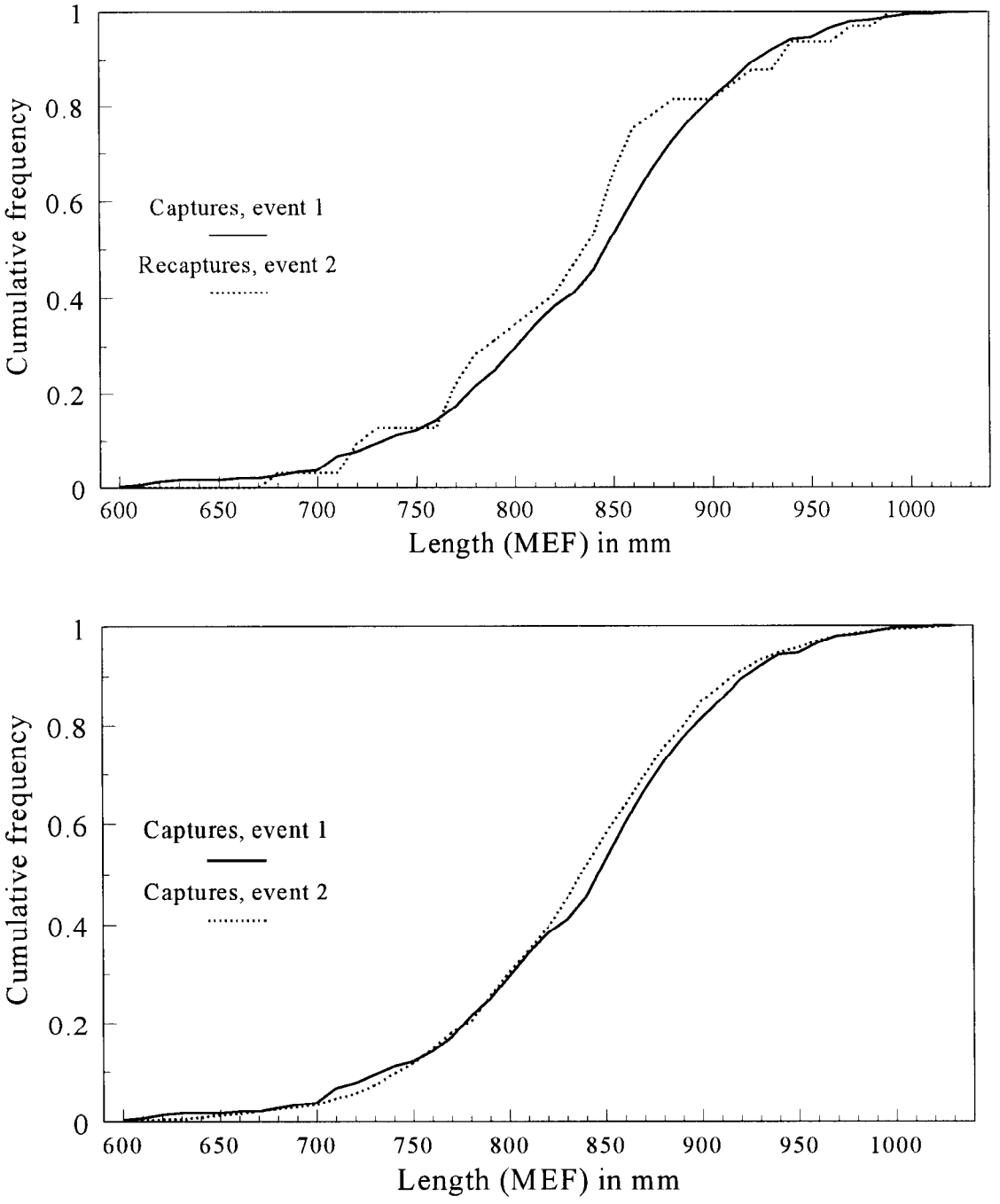

Figure 5.-The cumulative distribution function (CDF) of lengths (MEF) of large (≥age 1.3) chinook salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds (top) and versus lengths of large fish examined for marks on the spawning grounds (bottom), 1994.

Table 7.-Estimated angler effort, and large (≥28 in) chinook salmon catch and harvest in the Haines marine boat sport fishery for similar sample periods, 1984-1994.

Year	Survey dates	Effort				Large (>28″) Chinook Salmon				
		Total angler hours	SE	Salmon hours	SE	Catch	SE	Harvest	SE	CPUE[a]
1984[b]	5/06-6/30	10,253	c	9,855	c	1,072	c	1,072	c	0.109
1985[d]	4/15-7/15	21,598	c	20,582	c	1,705	c	1,696	c	0.083
1986[e]	4/14-7/13	33,857	c	32,533	c	1,659	c	1,638	c	0.051
1987[f]	4/20-7/12	26,621	2,557	22,848	2,191	1,094	189	1,094	189	0.048
1988[g]	4/11-7/10	36,222	3,553	32,723	3,476	505	103	481	101	0.015
1989[h]	4/24-6/25	10,526	999	9,363	922	237	42	235	42	0.025
1990[i]	4/23-6/21	i	i	11,972	1,169	248	60	241	57	0.021
1993[j]	4/26-7/18	11,919	1,559	9,069	1,479	349	63	314	55	0.038
1994	5/09-7/03	9,726	723	7,682	597	269	41	220	32	0.035
84-86 average		21,903		20,990		1,479		1,469		0.070
89-94 average		10,724		9,522		276		253		0.029

[a] Catch of large chinook salmon per salmon hour of effort.

[b] From Neimark (1985).

[c] Estimates of variance were not provided until 1987.

[d] From Mecum and Suchanek (1986).

[e] From Mecum and Suchanek (1987).

[f] From Bingham et al. (1988).

[g] From Suchanek and Bingham (1989).

[h] From Suchanek and Bingham (1990).

[i] From Suchanek and Bingham (1991), no estimate of the total angler effort and harvest was provided.

[j] From Ericksen (1994).

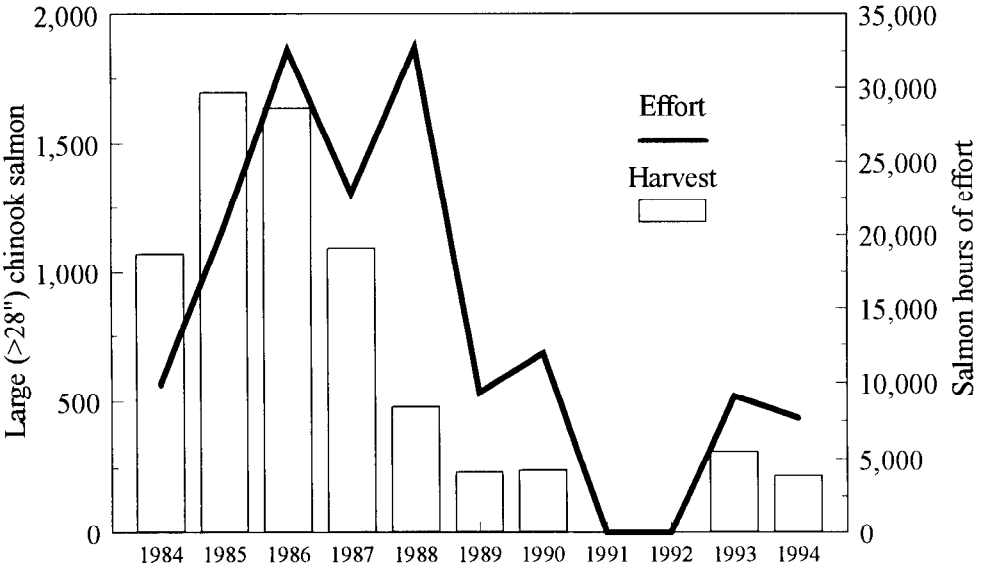

Figure 6.-Estimated angler effort and harvest of large (≥28 in) chinook salmon in the Haines spring marine boat sport fishery, 1984-1994. Data taken from Table 7 (fishery was closed in 1991 and 1992).

Table 8.-Estimated contributions of hatchery produced chinook salmon to the Haines marine sport boat fishery, 1984-1994.

	Hatchery chinook salmon		Percent of
Year	Contribution	SE	Harvest
1984[a]	0	0	0
1985[b]	0	0	0
1986[c]	0	0	0
1987[d]	14	[d]	1
1988[e]	0	0	0
1989[f]	8	6	3
1990[g]	16	7	6
1993[h]	37	17	12
1994	6	4	3

[a] From Neimark (1985).

[b] From Mecum and Suchanek (1986).

[c] From Mecum and Suchanek (1987).

[d] From Bingham et al. (1988), no estimate of variance was provided.

[e] From Suchanek and Bingham (1989).

[f] From Suchanek and Bingham (1990).

[g] From Suchanek and Bingham (1991).

[h] From Ericksen (1994).

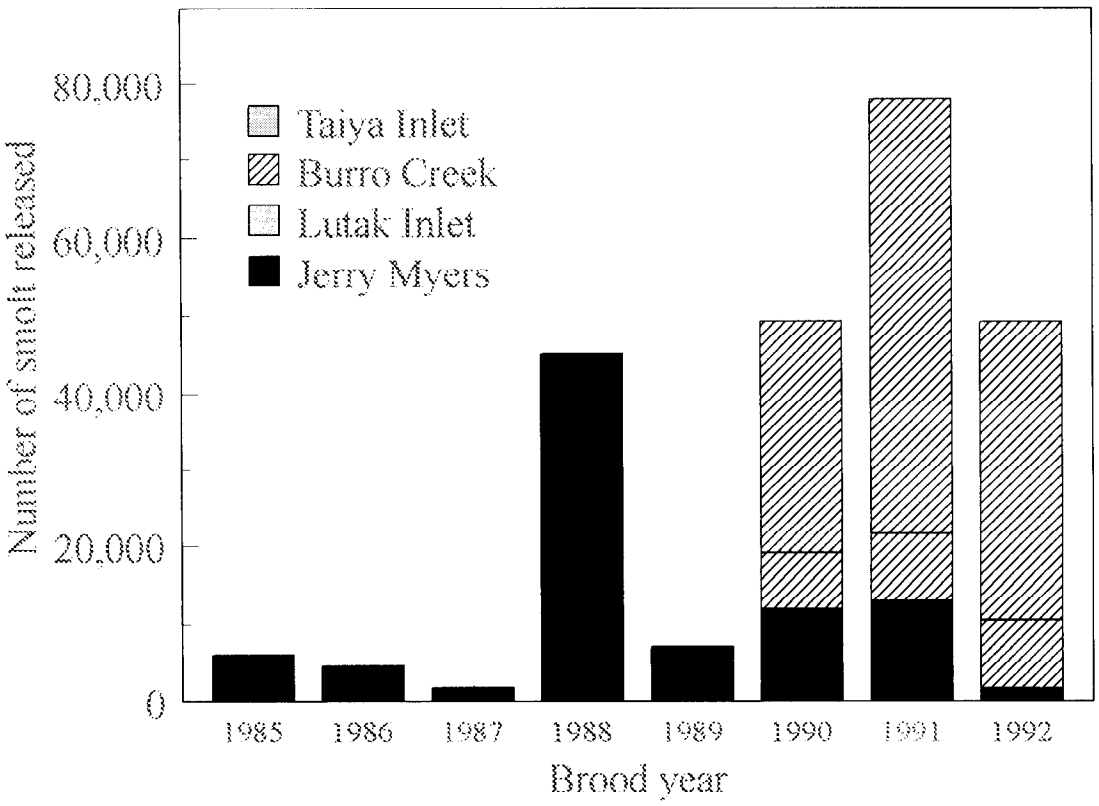

Figure 7.-Hatchery chinook salmon releases in Lynn Canal north of Haines by brood year and release site, 1985-1992. Taiya Inlet and Lutak Inlet salt water pen releases were reared to smolt stage at the Hidden Falls facility. Adults are expected to return primarily at age 1.3 and 1.4 (e.g., 1990 brood year releases are expected to return as adults in 1995 and 1996).

proportion to their numbers immigrating over time, or that immigration timing of the stocks was similar and sampling for marks on fish spawning in the areas sampled was random; (b) untagged fish did not recruit to the population between sampling events; (c) tagged and untagged fish suffered similar mortality rates between sampling events; and (d) that fish did not lose marks. Considerable efforts were made to catch and mark fish in proportion to their abundance (assumption a) during the immigration by sampling uniformly across the escapement. Also, we failed to reject the hypothesis that tagging ratios on the Tahini (p = 0.020:1) and Kelsall-Nataga (p = 0.050:1) Rivers were different. To achieve a random sample during the second sampling event, carcass sampling must not be size selective. Size selective sampling was not apparent during either sampling event. Carcass surveys are known to be selective for females in some situations (Pahlke et al. *In prep.*), however, sex ratios of large chinook salmon were not significantly different between the sampling and recovery events (χ^2 = 0.969, df = 1, P = 0.325). Sampling effort for tags on the Kelsall and Tahini rivers (where >90% of spawning occurred in 1991 and 1992), was fairly constant across the time when spawning fish die and are available for sampling. Previous research on the Chilkat River (Johnson et al. 1992, 1993) suggest

immigration timing is similar for Tahini and Kelsall River stocks. Thus, we conclude assumption (a) appears fairly robust for this experiment. Assumption (b) is reasonable since tagging continued until only about one fish a day was being caught. Recapture rates of fish tagged in the gill net (0.132) and the fish wheels (0.060) seemed different which provides evidence of a failure of assumption (c), (ie. higher mortality , or different stocks of fish tagged at the fish wheels). However, we could not reject the hypothesis that the two recovery rates were the same at $\alpha = 0.05$ ($\chi^2 = 3.2$, df = 1, $P = 0.074$). Tag loss was not observed in any of the tagged fish recovered during the experiment (assumption d), any missing tags would have been easily detected by the secondary mark (opercular-punch).

The 1994 immigration of 6,795 (SE = 1,057) appears to be the highest since abundance estimates were initiated in 1991 (Table 9), although the estimate is not significantly different from other years. However, other indicators (subsistence reports and field observations) concur that abundance was higher in 1994. This could be attributed to the relative strength of the 1988 brood year in 1994 (Table 10). Similarly, the low relative abundance estimated during 1993 was thought to be a result of the low relative strength of the 1987 brood year (Table 10, and Johnson 1993).

Sex was estimated with significant uncertainty early in the season. Three out of 21 marked fish that were sexed as female during the marking event and later recaptured, were sexed as male when recaptured (Table 11). We assume that they were sexed correctly on the spawning grounds since sexual dimorphism was more evident. An examination of data collected in prior years (Table 11) indicates that the proportion of females is consistently overestimated during the marking event. Sex composition during the marking event should therefore be viewed with great caution.

Recent analysis of genetic samples collected from chinook salmon in the Chilkat River drainage indicates that populations spawning in Big Boulder Creek, Tahini River, and Kelsall River, while similar, are distinct (Bill Templin, Alaska Department of Fish and Game, Anchorage, personal communication). Although sample sizes were small in the analysis, evidence is sufficient to argue for a "conservative approach to management". For example, stocks should not be transplanted between tributaries.

Given current escapements of chinook salmon to the Chilkat River, the sport fishery harvest can and probably should increase. The 1994 estimated harvest of 190 wild mature chinook salmon represents about 3% of the estimated 1994 escapement of large chinook into the Chilkat River drainage. Several options are available to quickly increase this harvest, including increasing sport fishing effort (through promotions or reinstating the derby), reducing the area in Chilkat Inlet closed to chinook salmon harvest, or liberalizing the seasonal bag limit. However, there remains a perception with local anglers that the Chilkat River stock is much lower than a decade ago. In fact, CPUE levels in recent years are about one half of what they were historically (Table 7). However, anglers were permitted to fish closer to the river mouth in the mid-1980's which may explain the difference in the CPUE's. Measures to expand this harvest should proceed cautiously until optimum escapement goals can be revised to reflect our present knowledge of this unique and important stock.

Table 9.-Parameters used to estimate abundance of large (≥age 1.3) chinook salmon to the Chilkat River, 1991-1994.

	1991[a]	1992[b]	1993[c]	1994
	Number marked			
Drift gill net	80	148	159	212
Fish wheels	145	NA[d]	NA	84
Total	225	148	159	296
	Number examined			
Kelsall/Nataga				
Examined	507	571	445	482
Recoveries	15	18	15	24
Tahini River gill net				
Examined	155	158	90	NA
Recoveries	9	4	4	NA
Tahini River carcass[e]				
Examined	39	156	43	250
Recoveries	2	1	1	5
Big Boulder Creek				
Examined	30	20	36	44
Recoveries	0	0	1	4
All recovery areas				
Examined	733[f]	905	614	777
Recoveries	27[f]	23	21	33
	Abundance			
Estimate	5,897	5,284	4,472	6,795
SE	1,005	949	851	1,057
Relative precision[g]	0.33	0.35	0.37	0.30

[a] Taken from Johnson et al. (1992).

[b] Taken from Johnson et al. (1993).

[c] Taken from Johnson (1994).

[d] NA = not applicable.

[e] Data was not collected in a comparable manner between years.

[f] Includes capture data from other systems.

[g] Relative precision = 1.96 Standard Error/estimate.

Table 10.-Estimated annual age compositions[a] and brood year returns of large (≥age 1.3) chinook salmon immigrating into the Chilkat River

Return year		Age class 1.3	1.4	1.5	Total
1994	Number sampled	63	112	3[b]	178
	Percent	35.4	62.9	1.7	100
	SE	3.6	3.6	1.0	
	Abundance	2,405	4,276	114	6,795
	SE	445	708	67	1,057
1993[c]	Number sampled	59	58	2	119
	Percent	49.6	48.7	1.7	100
	SE	4.6	4.6	1.2	
	Abundance	2,218	2,178	76	4,472
	SE	468	461	54	851
1992[d]	Number sampled	39	83	0	122
	Percent	32.0	68.0	0	100
	SE	4.2	4.2		
	Abundance	1,689	3,595	0	5,284
	SE	375	682		949
1991[e]	Number sampled	104	83	4	191
	Percent	54.4	43.5	2.1	100
	SE	3.6	3.6	1.0	
	Abundance	3,211	2,563	123	5,897
	SE	586	484	64	1,005
Average	Percent	42.8	55.8	1.4	
	Abundance	2,381	3,153	78	5,612

Brood year returns

Brood year	Age class 1.3	1.4	1.5	Total	SE
1984			123		
1985		2,563	0		
1986	3,211	3,595	76	6,882	901
1987	1,689	2,178	114	3,981	598
1988	2,218	4,276		6,494	849
1989	2,405				
Average	2,381	3,153	78	5,612	

[a] Estimated as the age composition in the drift gill net multiplied by the estimated abundance.

[b] Includes one fish aged 2.3 (same brood year).

[c] Estimated from Johnson et al. (1992).

[d] Estimated from Johnson et al. (1993).

[e] Estimated from Johnson (1994).

Table 11.-Sex determinations of chinook salmon which were uniquely marked in the lower Chilkat River then recaptured on the spawning grounds[a], by year, 1991 -1994.

		At marking		At recapture		Difference	Percent females were
Year	Sex	Number	Percent	Number	Percent	(in females)	over-estimated
1991	Male	9	37.5	12	50.0		
	Female	15	62.5	12	50.0	-3	25.0
1992	Male	11	45.8	15	62.5		
	Female	13	54.2	9	37.5	-4	44.4
1993	Male	8	38.1	10	47.6		
	Female	13	61.9	11	52.4	-2	18.2
1994	Male	11	34.4	14	43.8		
	Female	21	65.6	18	56.3	-3	16.7
Total	Male	39	38.6	51	50.5		
	Female	62	61.4	50	49.5	-12	24.0

[a] Derived from unpublished data collected by the Alaska Department of Fish and Game, Division of Sport Fish. Includes both large and small chinook salmon, but does not include fish that were not sexed on the spawning grounds.

ACKNOWLEDGMENTS

I would like to thank the creel survey staff of Elizabeth Wilson, Anne Sutton and Patricia Kermoian for their invaluable data collection efforts and suggestions to improve survey techniques. Suzanne Crete, Elizabeth Wilson, Eric Holle, Sherrie Duncan, Anne Sutton, and Dan Henry worked in the field to capture, mark, and sample fish to complete this project. Sue Millard and Scott McPherson of the Division of Sport Fish in Douglas processed and aged scales from sampled chinook salmon. Scott McPherson also provided input into the study design and analysis. Bob Johnson of the Division of Sport Fish in Douglas provided data from past years to aid in the design of this study. Employees at the ADF&G Tag Lab in Juneau dissected heads from adipose fin clipped chinook to remove and read coded wire tags. Special thanks to Sam Bertoni and Anna Sharp at the tag lab, for providing timely CWT data summaries and answering my many requests for information. Donna Buchholz and Gail Heineman of the Research and Technical Services (RTS) Unit of the Division of Sport Fish processed mark sense forms and provided data control. Paul Suchanek of the Division of Sport Fish in Douglas and Allen Bingham of the RTS Unit in Anchorage provided data from past surveys that were useful in planning this survey. Bob Marshall with RTS in Douglas provided biometric support in the study design, and analysis. Finally, Bob Marshall, Steve Elliott, and Scott McPherson provided critical review of this report.

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APPENDIX A

Appendix A1.-Estimated effort, catch, and harvest of chinook salmon at the Letnikof Dock by week, May 9 through July 3, 1994.

	May 09 May 15	May 16 May 22	May 23 May 29	May 30 June 05	June 06 June 12	June 13 June 19	June 20 June 26	June 27 July 03	Total
Boats Counted	6	47	27	66	97	50	23	20	336
Angler-hs. Sampled	30	312	204	618	801	366	143	153	2,627
Salmon-hs. Sampled	29	294	204	603	801	366	128	134	2,559
Chinook Sampled	0	3	10	11	34	16	3	2	79
Angler-hours									
Estimate	70	576	392	1,094	1,499	942	435	424	5,432
Variance	1,036	31,344	3,127	75,745	23,302	41,979	15,092	7,989	199,614
Salmon-hours									
Estimate	68	533	392	1,069	1,499	942	401	380	5,284
Variance	1,048	24,375	3,127	72,523	23,302	41,979	12,944	9,192	188,490
Large Chinook Catch									
Estimate	0	5	18	21	104	53	7	5	213
Variance	0	4	28	12	654	605	28	12	1,343
Large Chinook Kept									
Estimate	0	5	18	19	78	39	7	5	171
Variance	0	4	28	14	330	244	28	12	660
Wild Mature Chinook Kept									
Estimate	0	5	13	14	76	37	5	5	155
Variance	0	4	12	20	349	206	12	12	615
Small Chinook Catch									
Estimate	0	1	2	28	62	24	2	5	124
Variance	0	0	1	110	735	225	3	12	1,086

Appendix A2.-Estimated effort, catch, and harvest of chinook salmon at the Chilkat State Park boat launch, by bi-week, May 23 through July 3, 1994.

	May 23 June 05	June 06 June 19	June 20 July 03	Total
Boats Counted	4	11	12	27
Angler-hs. Sampled	29	88	90	207
Salmon-hs. Sampled	29	88	56	173
Chinook Sampled	0	3	1	4
Angler-hours				
Estimate	200	616	627	1,443
Variance	11,141	25,704	197,411	234,256
Salmon-hours				
Estimate	200	616	392	1,208
Variance	11,141	25,704	96,180	133,025
Large Chinook Catch				
Estimate	0	28	7	35
Variance	0	168	42	210
Large Chinook Kept				
Estimate	0	21	7	28
Variance	0	210	42	252
Wild Mature Chinook Kept				
Estimate	0	7	7	14
Variance	0	42	42	84
Small Chinook Catch				
Estimate	21	0	0	21
Variance	378	0	0	378

Appendix A3.-Estimated effort, catch, and harvest of chinook salmon at the Small Boat Harbor, by bi-week, May 9 through July 3, 1994.

	May 09 May 22	May 23 June 05	June 06 June 19	June 20 July 03	Total
Boats Counted	13	14	4	10	41
Angler-hs. Sampled	65	118	19	131	333
Salmon-hs. Sampled	57	108	16	8	189
Chinook Sampled	0	1	2	0	3
Angler-hours					
Estimate	303	826	133	1,589	2,851
Variance	7,903	21,378	7,602	51,450	88,333
Salmon-hours					
Estimate	266	756	112	56	1,190
Variance	6,038	20,706	5,712	2,688	35,144
Large Chinook Catch					
Estimate	0	7	14	0	21
Variance	0	42	84	0	126
Large Chinook Kept					
Estimate	0	7	14	0	21
Variance	0	42	84	0	126
Wild Mature Chinook Kept					
Estimate	0	7	14	0	21
Variance	0	42	84	0	126
Small Chinook Catch					
Estimate	0	42	7	0	49
Variance	0	1,512	42	0	1,554
Small Chinook Kept					
Estimate	0	0	7	0	7
Variance	0	0	42	0	42

Appendix A4.-Computer data files used in the analysis of this study in 1994.

File name	Description
94CWTREC.TXT	Text file containing recoveries of coded wire tagged (CWT) chinook salmon during 1994. Includes all recoveries in the Haines marine sport fishery, and in the escapement into the Chilkat and Chilkoot Rivers. Recoveries from all areas and gear, of CWT'd chinook that were released in the upper Lynn Canal and Chilkat River are also included.
94FWCAT.XLS	Excel spreadsheet containing individual length, sex, and tagging (if applicable) data on chinook salmon captured in the fish wheels operating in the Chilkat River during 1994.
94GNCAT.XLS	Excel spreadsheet containing individual length, sex, and tagging (if applicable) data on chinook salmon captured in drift gill nets fished in the lower Chilkat River during 1994.
94SPAWN.XLS	Excel spreadsheet containing individual length, sex, and tag recovery (if applicable) data on chinook salmon captured on the spawning grounds (Kelsall, Nataga, Tahini, and Big Boulder) during 1994..
F0810A_4.DTA	Mark sense ASCII file containing age, length data from chinook salmon sampled in the Haines marine sport fishery in 1994.
F0810MA4.DTA	Mark sense ASCII file containing angler interview data from the Haines marine sport fishery in 1994.
F107DAA4.DTA	Mark sense ASCII file containing age, length data from chinook salmon captured in the drift gill net operating in the lower Chilkat River during 1994.
F107FAA4.DTA	Mark sense ASCII file containing age, length data from chinook salmon sampled captured in the fish wheels that operated in the lower Chilkat River during 1994.
F1130AA4.DTA	Mark sense ASCII file containing age, length data from chinook salmon sampled on the Kelsall/Nataga spawning grounds during 1994.
F1380AA4.DTA	Mark sense ASCII file containing age, length data from chinook salmon sampled on the Big Boulder Creek spawning grounds during 1994.
F1390AA4.DTA	Mark sense ASCII file containing age, length data from chinook salmon sampled on the Tahini River spawning grounds during 1994.